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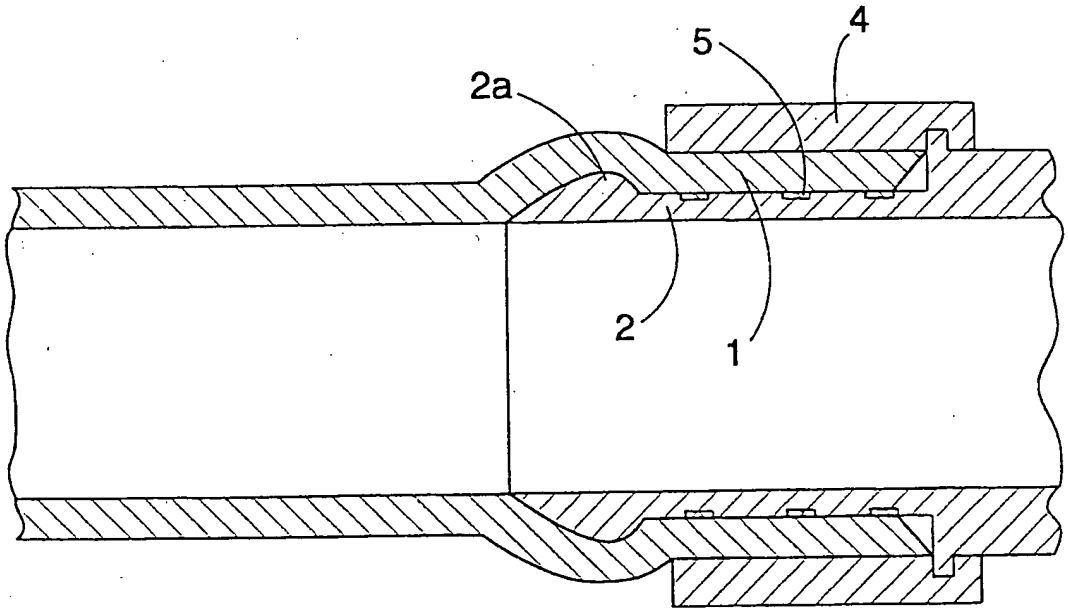

(57) Abstract

The invention relates to a method of making a pipe connection and to a pipe connection where an insert end (2) having an outer diameter that is larger than the inner diameter of the pipe (1) is inserted into the pipe (1). A flexible pressure ring (4) is then transferred on the connection, the inner diameter of the ring being normally smaller than the outer diameter of the pipe (1) transferred on the insert end (2). The connection is easy to make and it is also applicable for pipes with a large diameter, and the connection is strong and tight due to the flexible pressure ring.

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METHOD FOR MAKING A PIPE CONNECTION, AND A PIPE CONNECTION

The invention relates to a method of making a pipe connection, where an elastic pipe and an insert end to be arranged inside the pipe are transferred within each other, the outer diameter of the insert end being larger than the inner diameter of the pipe, and after the insert end and the pipe have been arranged within each other, a flexible pressure ring with an initial inner diameter that is normally smaller than the outer diameter of the pipe transferred on the insert end is transferred on the pipe and the insert end.

The invention further relates to a pipe connection comprising an elastic pipe, an insert end arranged inside the pipe, and a flexible pressure ring arranged outside these parts, the pressure ring being transferred on the pipe connection formed by the insert end and the pipe.

German Publication 4,003,740 discloses a pipe connection where an insert end is pushed inside a pipe, and an inflexible ring is transferred on the connection. A pipe used in such a connection must be very elastic so that the inflexible ring can be transferred on the connection. Such an inflexible ring does not produce sufficient compression under all circumstances.

Danish Publication 135,908 also discloses a pipe connection where an inflexible pressure ring is transferred on a connection formed by an insert end and a pipe. The insert end comprises two protrusions, between which the pressure ring is transferred. One of the protrusions is lower, and the pressure ring is pushed over this lower protrusion. The pipe must be made of a very elastic material so that it yields and thus makes it possible to push the inflexible pressure ring over the lower protrusion. The ring does not produce a compression force, but the firmness of the connection is ensured by the protrusions which are provided at the insert end and against which the ring is pressed when the connection is subjected to stress.

Swedish Patent 501,579 discloses a pipe connection where the thermal expansion coefficients of an insert end and a locking ring are selected such that the thermal expansion coefficient of the locking ring is greater than that of the material of the insert end. The connection can thus be maintained tight at different temperatures. Further, in order to seal the connection, the insert end comprises annular protrusions. The connection is therefore fairly tight, but for example where connections of pipes with a large diameter are concerned, even tighter simple connections are often needed.

German Patents 3,608,843 and 2,510,886 and German Utility Model G 8,802,366.4 disclose pipe connections where a pipe is pushed on an insert end, and an inflexible pressure ring is pushed on the connection. Again the pipe must be very elastic so that a satisfactory connection can be achieved. The connections are also very complicated, and sufficiently tight connections are not always achieved.

Finnish Patent 33,301 discloses a pipe connection where a pressure sleeve is contracted on the connection. The connection is difficult and complicated to make, and so it is not useful.

Finnish Patent Application 954,549 discloses a pipe connection where an insert end and a pipe are pushed within each other by means of a hydraulic insertion device. Before the connection is made, the end of the pipe is expanded. The method is cumbersome in this respect.

European Publication 0,530,387 discloses a pipe connection where a pipe and a flexible ring provided on it are expanded simultaneously and subsequently placed on an insert end. The inner diameters of the insert end and the pipe can here be equal, but the method is rather complicated and cumbersome and therefore not suitable, for example, for connecting pipes having a large diameter.

U.S. Patent 2,433,602 discloses a pipe connection where a pressure ring made of rubber is transferred on a pipe and an insert end. To ensure tightness, a metallic split ring is placed on the rubber ring. The rubber must be so soft and yielding that the effect of the compression of the metallic split ring on the connection is sufficiently strong. This kind of connection is difficult to make.

The object of the present invention is to provide a simple method of making a pipe connection, and a pipe connection, also applicable for use in connection with pipes having large diameters.

The method of the invention is characterized in that the material used for the pressure ring is plastic having a low creep, so that the elastic pressure ring as such together with the contraction force of the pipe ensures long-term tightness of the connection.

Further the pipe connection of the invention is characterized in that the material used for the elastic pressure ring is plastic having a so low creep that the pressure ring as such together with the contraction force of the pipe ensures long-term tightness of the connection.

The essential idea of the invention is that the insert end having an outer diameter that is larger than the inner diameter of the pipe is inserted into the pipe and that a flexible pressure ring is subsequently transferred on the connection, the inner diameter of the ring being normally smaller than the outer diameter of the insert end and the pipe placed within each other. Further, the material of the pressure ring is plastic having a low creep. The idea of a preferred embodiment is that a bevel is provided inside the end of the pipe so as to facilitate the insertion of the insert end.

The advantage of the invention is that a connection is simple and easy to make. The connection is also strong and tight. When a bevel is provided at the end of the pipe, the insert end can be easily inserted into the pipe, and the inner diameter of the insert end can be equal to the inner diameter of the pipe.

The invention will be described in greater detail in the accompanying drawings, in which

Figure 1 shows a situation before a pipe connection is made,

Figure 2 shows a pipe connection according to the invention,

Figures 3a to 3d are a schematic presentation of a method of making a pipe connection,

Figure 4 shows elasticity properties of two materials, and

Figure 5 shows another pipe connection according to the invention.

Figures 1 and 2 show a pipe 1 and an insert end 2. The pipe 1 is made of a slightly elastic material, for example of rubber or plastic, and the inner diameter of the pipe 1 can be smaller than the outer diameter of the insert end before a pipe connection is made. The material of the insert end 2 is selected in such a way that its creep properties are equal to or better than those of the material of the pipe 1. The insert end 2 can thus be made, for example, of corrosion-protected metal, cross-linked polyethylene reinforced with glass fibre, or plastic, such as polysulfone, having a high elasticity modulus. The insert end 2 can also be, for example, a fitting or an end of a pipe, for example, of a pipe identical to pipe 1.

Before a pipe connection is made, the end of the pipe 1 can be provided with a bevel 3, indicated by a broken line in Figure 1. The bevel considerably facilitates the insertion of the insert end 2 into the pipe 1. On account of the bevel 3, the inner diameter of the insert end 2 can be equal to the inner diameter of the pipe 1. After the insert end 2 and the pipe 1 have

been pushed within each other, a pressure ring 4 is transferred on the connection to ensure its tightness. The inner diameter of the pressure ring is normally smaller than the outer diameter of the insert end 2 and the pipe 1 placed within each other. However, the pressure ring 4 is made of elastic material so that it can be transferred on the connection. When situated on the connection, the pressure ring 4 shows a tendency to revert to its normal size, thereby pressing the connection and ensuring its tightness. Various types of plastic can be used as the material of the pressure ring 4. A good pressure ring 4 typically has a fairly high elasticity modulus, good elongation properties and especially good creep properties, i.e. it has a low creep. The creep of the pressure ring 4 is so low that apart from the pressure ring 4 no additional pressure is needed: the pressure ring 4 as such together with the contraction force of the pipe 1 ensure long-term tightness of the connection. If the creep properties are extremely good, the pipe 1 to be connected need not necessarily have good creep properties. A suitable method for determining the creep ratio is set forth in ISO 9967. A conventional way of lowering the creep is to add for example reinforcements, such as glass fibre, to the material. This, however, cannot be used in connection with the pressure ring 4 of the present invention, since the addition of for example glass fibre impairs the elongation properties, and so the material does not endure as great elongation as needed in connection with the pressure ring 4. A suitable method for detecting the strain allowed for the material of the pressure ring is described in "Ermittlung der kritischen Dehnung teilkristalliner Thermoplaste", Prof G. Menges et al, Kunststoffe, Bd. 65, 1975, H.6. This publication describes a fast method for establishing the critical strain of plastic materials that should not be exceeded in well-designed plastic constructions. For example, material 1 described in Figure 4 is a good material. Material 1 has a higher elasticity but a lower creep than material 2. Ideally, the short-term creep modulus of the pressure ring 4 is the same as or higher than that of the pipe 1. Similarly, the long-term creep modulus of the pressure ring 4 is at least the same as that of the pipe material. Preferentially the long-term creep modulus (100 year value) of the pressure ring material is not less than 50 % of the 24-hour value. An excellent material for the pressure ring 4 is cross-linked polyethylene, i.e. PEX, which has been cross-linked to a gel content of at least 60 %. In order to increase the initial compression force of the ring, the pressure ring can be made of oriented PEX, which doubles the original values. Polyketone is also a suitable material for

the pressure ring 4 since it has a high elasticity modulus and an exceptionally high elastic strain limit. The diameter of the pipe 1 can be fairly large, for example hundreds of millimetres.

At the end of the insert end there can be a protrusion 2a over which the pressure ring 4 can be pushed due to its flexibility. However, after the connection has been made, the protrusion 2a effectively prevents the pressure ring 4 from sliding off the connection. The material of the pressure ring 4 is selected and the height of the protrusion 2a is determined so that all handling of the pressure ring 4 takes place at the elastic area, whereby the pressure ring 4 tends to revert to its normal size after elongation. Further, the insert end 2 can be provided with a projection 2b, and correspondingly, the pressure ring 4 can be provided with a groove 4a, so that the pressure ring 4 and the insert end 2 can be locked firmly in the axial direction by means of the projection 2b and the groove 4a. The pressure ring 4 can be for example as long as or longer than the insert end 2 in the axial direction. Most preferably, however, the pressure ring 4 is substantially as long as the direct part of the insert end 2, as shown in Figure 2. The pressure ring 4 can also be conical, in which case the conical surface acts for example in a flange connection as a stop surface to the pipe flange. The pipe flange then presses the pressure ring 4 more tightly against the connection.

The height of the protrusion 2a is determined so that when the pressure ring 4 is pushed over the protrusion 2a, the diameter of the pressure ring 4 is expanded so as to facilitate the sliding of the end of the pressure ring 4 on the projection 2b.

Either the inner surface of the pressure ring 4 or the outer surface of the insert end 2, or both can be provided with friction grooves or protrusions so as to increase friction. If desired, the surfaces can be for example sand-blasted or treated otherwise in order to increase the roughness of the surfaces. In some cases the elasticity modulus of the pipe 1 to be connected is so high that the material of the pipe 1 does not easily go into the possible friction grooves at the insert end 2. In that case the end of the pipe 1 can be slightly heated, whereby the elasticity modulus decreases and the material goes into the friction grooves, and thus connection friction increases.

The insert end 2 can also comprise annular seals 5. The material of the seals 5 is most preferably plastic, such as PEX or LDPE, since the service life of the plastic is known fairly well, and therefore the service life of the

connection can also be predicted relatively accurately. The material of the seal 5 is softer than the pipe 1 to be connected. The pressure ring 4 can also contain material that can be heated so that the pressure ring welds onto the connection. For example, a colourant decomposing by the action of heat higher than the maximum operating temperature of the pipe can be blended in the pressure ring 4, the colourant reacting in the heat so that a heated connection has permanently a different colour than an unheated one. This makes it easy to detect afterwards whether a connection can be detached or whether it has been welded, since the colour of a welded connection has changed. The inner surface of the pressure ring 4 can comprise protrusions that are arranged to align with the seals 5 in the finished connection. The protrusions then press the seals 5 so that they become even tighter. The tightness of the connection is ensured on the inside of the pipe 1 by the friction of the seals 5, the insert end 2 and the edges of the grooves of the insert end, and on the outside of the pipe 1 by the friction of the protrusions of the pressure ring 4 and by the locking of the pressure ring 4 by means of the groove 4a and the projection 2b and by the deformation energy required to push the pressure ring 4 over the protrusion 2a. If the pressure ring 4 has not been welded onto the connection, the connection does endure tension but it can be detached by first removing the pressure ring 4 from around the connection.

Figures 3a to 3d are a schematic presentation showing the making of a pipe connection. The reference numerals of Figures 3a to 3d correspond to those of Figures 1 and 2. The pipe 1 and the insert end 2 are fastened to a mount, preferably for example to a welding carriage, which is not shown in the accompanying figures for the sake of clarity. In the first step, the end of the pipe 1 is provided with a bevel on the inside by means of a conical mandrel 6. Fastening means 7 are attached to the pipe 1 and the insert end 2. The fastening means 7 are connected to an actuator 8, which can be, for example, a hydraulic cylinder or some other such actuator known per se. The pipe 1 and the insert end 2 are moved toward each other by means of the actuator 8 so that they settle within each other. The compression of the fastening means 7 is then released from the pipe 1. However, the fastening means 7 is still moved toward the point of connection. The fastening means 7 is formed such that it can move the pressure ring 4 at this stage, so that the fastening means 7 pushes the pressure ring 4 on the connection. Pipe connections can thus be

made rapidly and reliably also where pipes with a rather large diameter are concerned.

Figure 5 shows another pipe connection according to the invention. The grip between the pipe 1 and the insert end 2 can be substantially improved by arranging between the insert end 2 and the pipe 1 a gripper, such as a rubber ring or a split metal ring, a double-sided sand paper or a metal net 9. The gripper greatly increases friction between the pipe 1 and the insert end 2. When the gripper is used, the outer surface of the insert end 2 can be even quite straight, and yet the connection remains sufficiently tight. The metal net 9 can be made, for example, of wires or of a metal sheet by punching. The essential feature is that the material of the metal net 9 comprises metal and that the net comprises apertures 9a. The gripper comprises heatable material, so that when the connection is heated the pipe 1 and the insert end 2 weld, attaching to each other. When, for example, a metal net 9 is used, the connection can be heated by induction heating, whereby the metal net 9 heats up, melting surrounding plastic material, so that the insert end 2 and the pipe 1 weld for example at the apertures 9a. The connection is thus rendered such that it cannot be detached. The use of induction heating for a connection according to the invention is particularly efficient, since apart from the metal net 9 the connection does not comprise any metal that could heat up by the effect of the induction.

The end of the pressure ring 4 can be provided with a bevel 10. The bevel 10 considerably facilitates the transfer of the pressure ring 4 on the projection 2b.

The drawings and the associated description are only intended to illustrate the inventive idea. The details of the invention can vary within the scope of the claims. A pipe connection for joining two pipes can thus also be made such that a pipe is inserted in each end of the insert end 2 and a flexible pressure ring is pushed on the connection so that the ring presses both the pipes against the insert end.

CLAIMS

1. A method of making a pipe connection, where an elastic pipe (1) and an insert end (2) to be arranged inside the pipe (1) are transferred within each other, the outer diameter of the insert end (2) being larger than the inner diameter of the pipe (1), and after the insert end (2) and the pipe (1) have been arranged within each other, a flexible pressure ring (4) with an initial inner diameter that is smaller than the outer diameter of the pipe (1) transferred on the insert end (2) is transferred on the pipe (1) and the insert end (2), **characterized** in that the material used for the pressure ring (4) is plastic with a low creep, so that the elastic pressure ring (4) as such together with the contraction force of the pipe (1) ensures long-term tightness of the connection.

2. A method according to claim 1, **characterized** in that the material used for the pressure ring is cross-linked polyethylene.

3. A method according to claim 1 or 2, **characterized** in that a bevel (3) is formed inside the end of the pipe (1) before the pipe (1) and the insert end (2) are transferred within each other.

4. A method according to any one of the preceding claims, **characterized** in that fastening means (7) are attached to the pipe (1) and the insert end (2), the fastening means (7) are pushed toward each other so that the pipe (1) and the insert end (2) settle within each other, the compression of the fastening means (7) is released from the pipe (1), and the fastening means (7) is then moved toward the point of connection so that the fastening means (7) simultaneously pushes the flexible pressure ring (4) on the connection.

5. A method according to any one of the preceding claims, **characterized** in that a gripper is provided between the insert end (2) and the pipe (1), the gripper comprising heatable material, and that the connection is heated so that the pipe (1) and the insert end (2) grip each other, whereby the connection is rendered such that it cannot be detached.

6. A pipe connection comprising an elastic pipe (1), an insert end (2) arranged inside the pipe, and a flexible pressure ring (4) arranged outside these parts, the pressure ring being transferred on the pipe connection formed by the insert end (2) and the pipe (1), **characterized** in that the material used for the pressure ring (4) is plastic with a so low creep that the

elastic pressure ring (4) as such together with the contraction force of the pipe ensures long-term tightness of the connection.

7. A pipe connection according to claim 6, **characterized** in that the material used for the pressure ring (4) is cross-linked polyethylene.

8. A pipe connection according to claim 6 or 7, **characterized** in that at the end of the insert end (2) there is a protrusion (2a), over which the flexible pressure ring (4) is transferred.

9. A pipe connection according to any one of claims 6 to 8, **characterized** in that a bevel (3) is formed inside the end of the pipe (1) before the connection is made.

10. A pipe connection according to any one of claims 6 to 9, **characterized** in that the insert end (2) is provided with plastic seals (5).

11. A pipe connection according to any one of claims 6 to 10, **characterized** in that the insert end (2) is provided with a projection (2b) and the pressure ring (4) is provided with a corresponding groove (4a), so that the pressure ring (4) can be locked onto the insert end (2) in the axial direction by means of said projection (2b) and said groove (4a).

12. A pipe connection according to claim 11, **characterized** in that at the end of the insert end (2) there is a protrusion (2a), the height of which is determined so that when the pressure ring (4) is transferred over the protrusion (2a), the diameter of the pressure ring (4) is expanded so as to facilitate the sliding of the end of the pressure ring (4) on the projection (2b).

13. A pipe connection according to any one of claims 6 to 12, **characterized** in that a gripper comprising heatable material is arranged between the insert end (2) and the pipe (1), the pipe connection being heated so that the insert end (2) and the pipe (1) attach to each other.

14. A pipe connection according to any one of claims 6 to 13, **characterized** in that the connection comprises heatable material and that the pressure ring (4) comprises colourant decomposing by the action of heat so that a heated connection has a different colour than an unheated one.

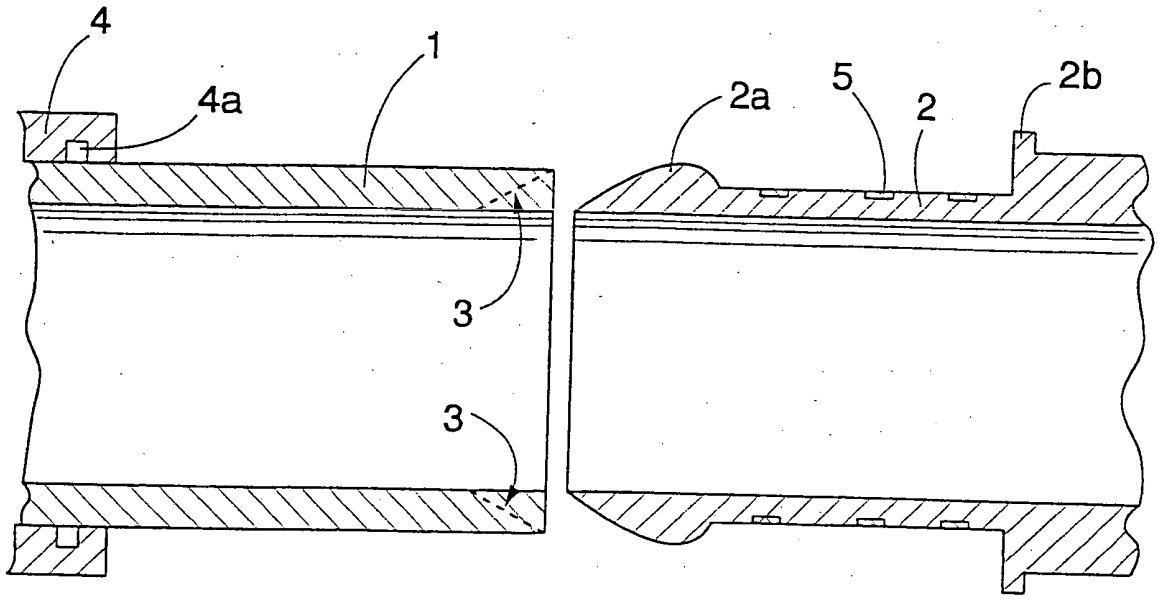

FIG. 1

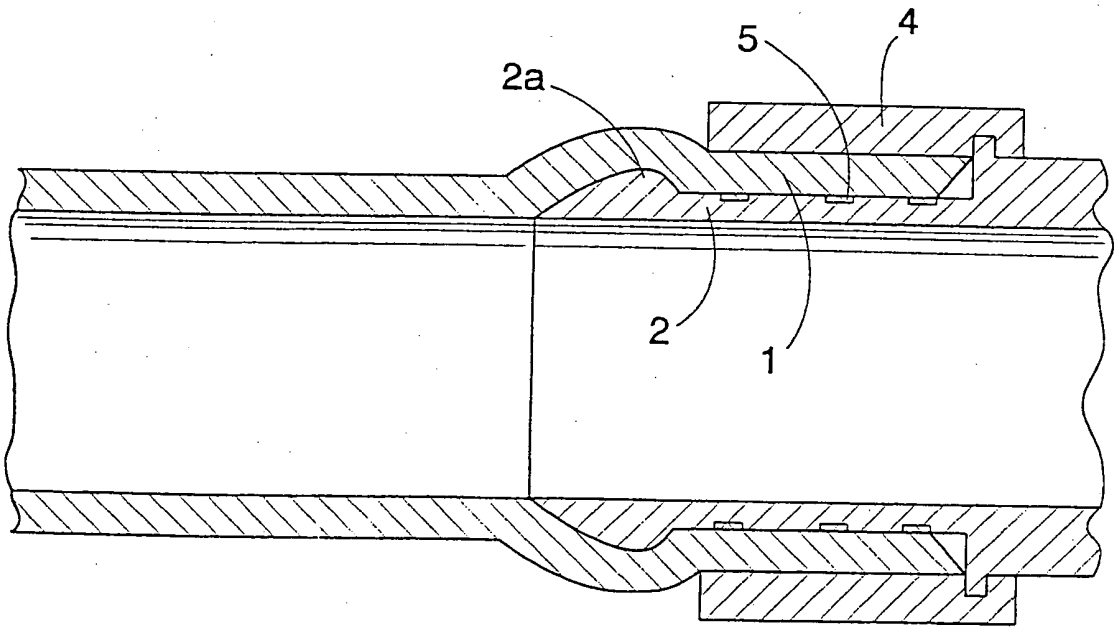

FIG. 2

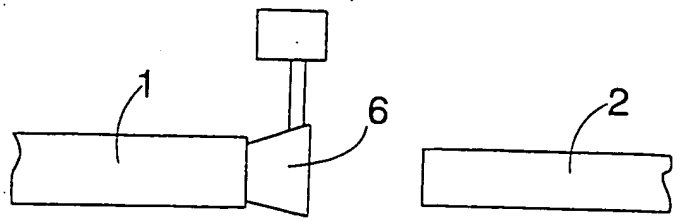

FIG. 3a

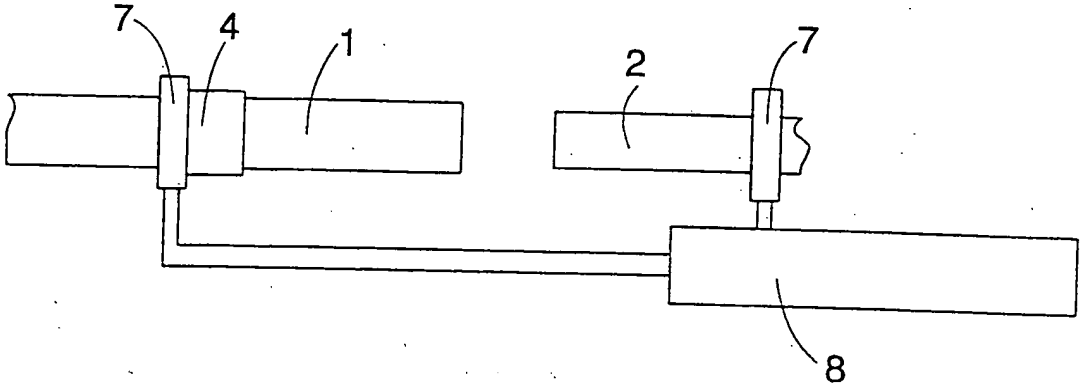

FIG. 3b

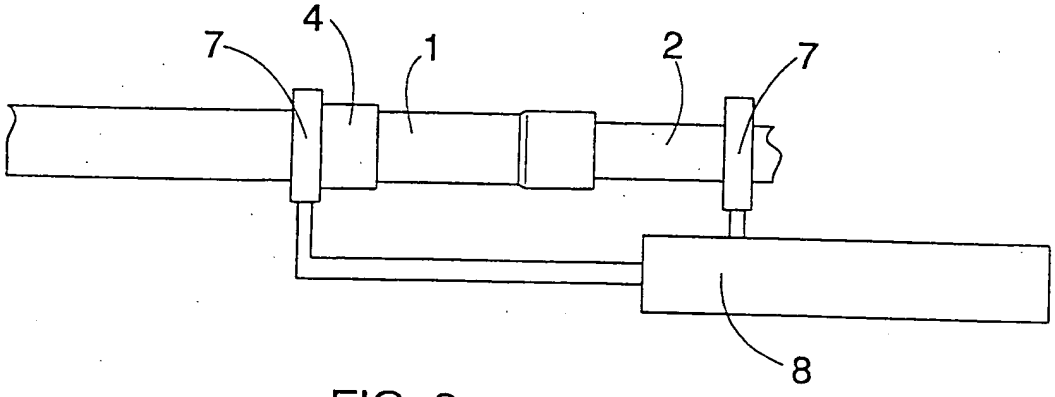

FIG. 3c

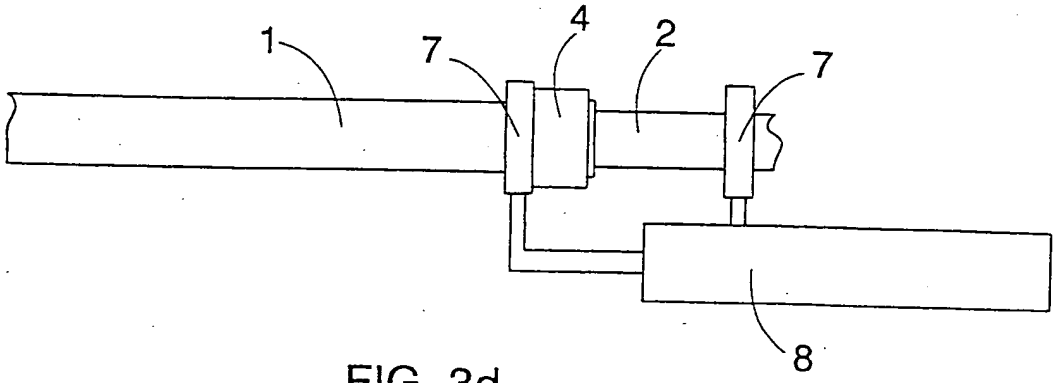

FIG. 3d

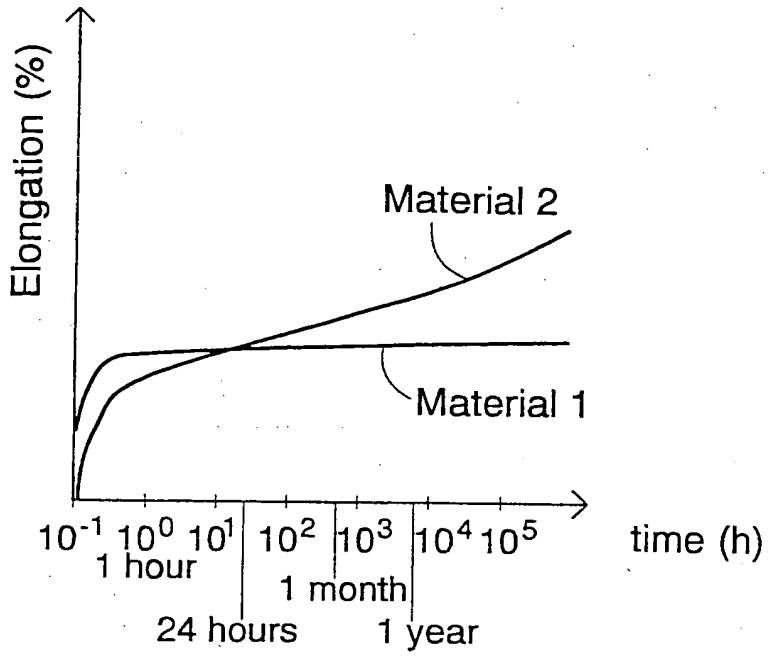
Elongation (%)
Material 2
Material 1
10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5}
time (h)
1 hour
24 hours
1 month
1 year

FIG. 4

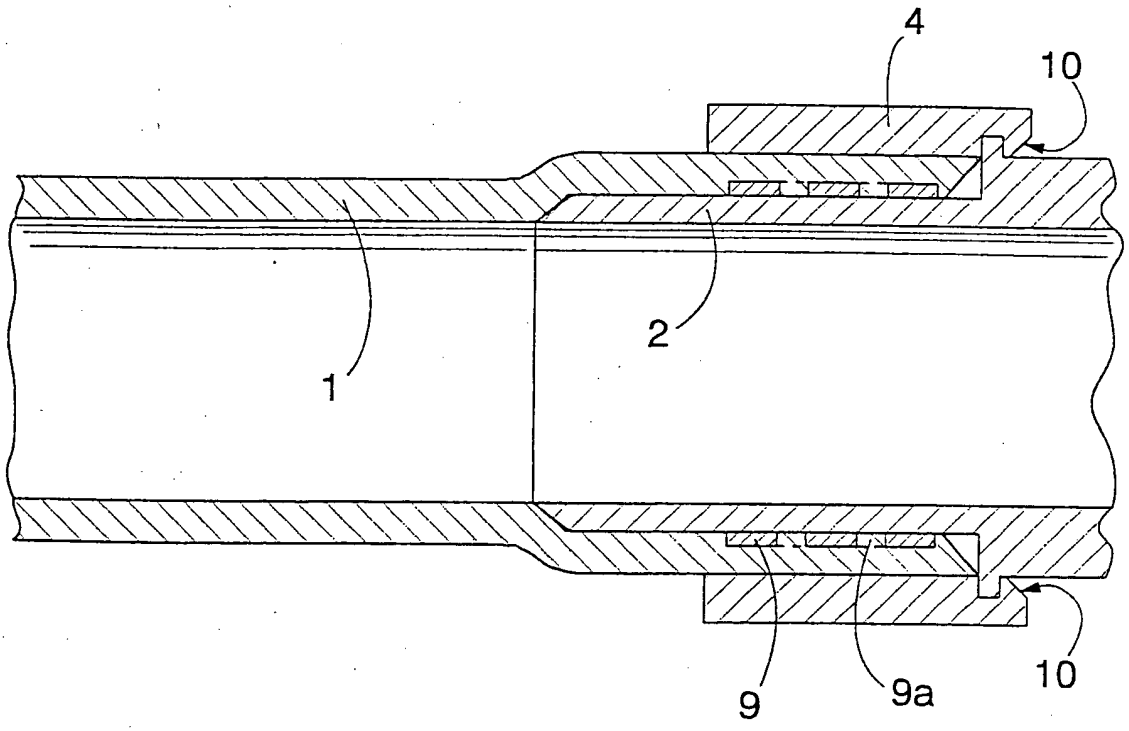
4
10
1
2
9
9a
10

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00223

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F16L 33/20
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2433602 A (G.R. COSS), 30 December 1947 (30.12.47), column 2, line 35 - line 52; column 3, line 14 - line 15; column 3, line 61 - line 68	1,6
Y		10,11
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Y	AT 377346 B (POLPLASTKUNSTOFFWERK DER ETERNIT-WERKE LUDWIG HATSCHEK UND DER DURIT-WERKE KERN & CO.), 11 March 1985 (11.03.85), figure 7	10
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Y	SE 459443 B (RASMUSSEN GMBH), 3 July 1989 (03.07.89), figures 1-3	11
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 June 1998	27 -06- 1998
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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NO 148686 B (HYDROTECH INTERNATIONAL, INC.), 15 August 1983 (15.08.83) -- --------	

INTERNATIONAL SEARCH REPORT

Information on patent family members

09/06/98

International application No.
PCT/FI 98/00223

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2433602 A	30/12/47	NONE	
AT 377346 B	11/03/85	NONE	
SE 459443 B	03/07/89	CA 1250333 A	21/02/89
		DE 3424675 A,C	16/01/86
		FR 2567246 A,B	10/01/86
		GB 2161568 A,B	15/01/86
		JP 1609508 C	28/06/91
		JP 2035190 B	08/08/90
		JP 61027387 A	06/02/86
		SE 8503336 A	06/01/86
		US 4635973 A	13/01/87
NO 148686 B	15/08/83	NONE	